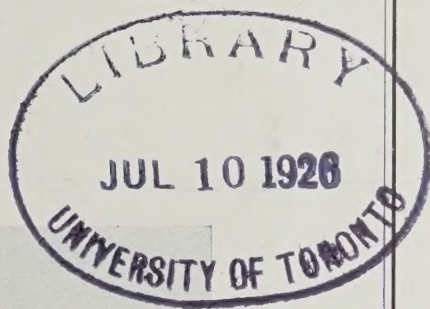


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THE RED-BACKED CUTWORM AND ITS CONTROL IN THE PRAIRIE PROVINCES

By KENNETH M. KING



A field of stubbled-in wheat in Saskatchewan, June 11, 1925, severely injured by the red-backed cutworm.
Where not destroyed by the cutworm the wheat was 6 to 8 inches high. (Original)

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TO CONTROL CUTWORMS USE POISONED BAIT.

Formula

1. Bran.....100 pounds
2. White Arsenic..... 4 pounds
(or Paris Green 2 pounds)
3. Cheap Blackstrap Molasses..... 1 gallon
4. Water..... 7 to 8 gallons

Thoroughly mix 1 and 2 dry; dissolve 3 in 4 and stir into the above until free from lumps. See page 8.

Broadcast on a warm evening. Apply thinly but evenly, making the above amount cover 5 acres of most crops. Page 9.

Use bait as soon as cutworm damage is found in fields of sweet clover, flax, sunflowers, corn, or in gardens. These are the crops most susceptible to injury. Pages 9 and 12.

Use as directed in fields of small grains or before re-seeding. Pages 10 and 11.

Poisoned bait is effective in controlling the red-backed cutworm. It is cheaper and easier to use bait than to re-seed. Page 10.

THE RED-BACKED CUTWORM AND ITS CONTROL IN THE PRAIRIE PROVINCES

By KENNETH M. KING, *Entomologist*,
Dominion Entomological Laboratory, Saskatoon, Sask.

SUMMARY

Cutworms are a constant crop hazard in the Prairie Provinces. Learn to know the three important cutworms, and to distinguish cutworm damage from that due to other causes, by observation and by sending forward specimens for identification.

The red-backed cutworm is the most important kind in Saskatchewan and Manitoba. The eggs which are laid in dry, loose soil during late summer, hatch in the spring, and the cutworms, feeding on the surface at night, attack the crops throughout a period from about May 15 to June 20.

Fully half the damage to field crops and 90 per cent of that to garden crops can easily be prevented.

No spring-sown crops immune to cutworm injury are known.

Fall rye is recommended as a resistant crop.

Cultural methods will reduce damage to the small grains—wheat, oats, barley and rye—and packing after seeding is particularly recommended.

The most effective control of the red-backed cutworm is secured by applying poisoned bait to the infested fields.

IMPORTANCE OF CUTWORMS

The red-backed cutworm (*Euxoa ochrogaster* Gn.) feeds upon a wide range of food plants, is the most widely distributed, and most generally destructive cutworm in Canada. Important damage by it has been recorded at one time or another from every province in the Dominion.

In the provinces of Saskatchewan and Manitoba, the red-backed cutworm is especially injurious, ranking as one of the major insect pests. Scarcely a year passes without a destructive infestation in some district, while in 1915 and 1925 there occurred general outbreaks involving the greater part of the agricultural area in both provinces. The damage caused directly by the work of cutworms in Saskatchewan in 1925 was estimated to have exceeded \$4,000,000. In the Indian Head district in the same year the total yield of all crops, was estimated to have been reduced one-fourth by cutworms. Many gardens were re-seeded as often as five or six times, and the loss of three to four seedlings in large fields was recorded.

Cutworms are so important and so generally widespread in the Prairie Provinces that each farmer should learn to distinguish the injurious species which occur in his district, and become familiar with the control measures of proven value.

HOW TO DISTINGUISH CUTWORM WORK

A poor stand of spring crop in a field is not always absolute proof of cutworm work. This may result from a number of causes such as "skips" due to a defective drill, the use of poor seed, formalin injury to the seed, poor germination due to cold or dry soil, weakening of the plants by root-rots, the work of gophers or damage by insects such as the Hessian fly, wireworms or cutworms.

A careful search for the cause of trouble must, therefore, be made before undertaking definite control measures. Thus, an examination should be made as soon as it is noticed that the crop is not coming up properly. In this search, examine a foot or two of row in several places in the field (digging up each single seed or plant). If insects are responsible for the poor appearance of the crop the characteristic damage will be seen and the insects will be found near at hand.

*Wireworms*¹ are hard, slim grubs, with flattened, bright, straw-yellow coloured bodies. They injure crops chiefly by boring into the seed or into the stem near the seed. Some of the control measures of value against wireworms are so different from those used against cutworms that it is essential to distinguish the two kinds of insects.

Cutworms (fig. 1) are soft, fat, worm-like caterpillars with round, dull-coloured bodies but shiny heads. They have the habit of rolling up in a ring when disturbed. The caterpillars themselves will usually be found in the loose soil near plants which they have cut during the night. The plants attacked are as a rule completely severed at or near the surface of the soil, and the upper parts of small plants may be entirely consumed.



FIG. 1.—Characteristic habit of cutworms. (After Gibson).

NECESSITY OF RECOGNIZING THE DIFFERENT SPECIES OF CUTWORMS

There are three cutworms which are of importance in the Prairie Provinces: the red-backed cutworm, the pale western cutworm, and the early cutworm. If an examination proves that cutworms are the cause of the damage in a field, it is then necessary to determine which of these three is involved in order to be able to select the best control.

THE RED-BACKED CUTWORM and some related species, as distinct from the other two mentioned, are by far the most important group in Saskatchewan and Manitoba. It is estimated that from 80 per cent to 90 per cent of the total cutworm damage in these provinces in 1925 was caused by them. Hence in most cases of injury in these provinces the control measures which should be used are those outlined in this pamphlet.

¹If wireworms are causing trouble in addition to the cutworms write to the author for the leaflet giving control measures. Where both pests are present in a field the two methods of control must be combined to meet the situation.

This group of cutworms may be recognized by the following characteristics: (1) the damage is caused during a period from about May 15, until the latter part of June; (2) the plants are usually cut at or just above the surface and the tops of smaller plants are usually entirely consumed; (3) the cutworms are dark-grey in colour on the upper half of the body, paler below and usually with two broad bands of a dull-red shade along the back.

THE PALE WESTERN CUTWORM² (*Porosagrotis orthogonia* Morr.) is the most important species in southern Alberta and is sometimes responsible for considerable damage in southwestern Saskatchewan. In 1925, it caused some injury in small patches in fields of the Indian Head-Abernethy district, and appears to be spreading. This cutworm occurs at the same time of the year as the red-backed cutworm, but may be distinguished from it by the uniformly pale colour of the slaty-grey body. The plants are almost invariably cut and devoured beneath the soil surface.

The use of poisoned bait has never proved successful against the pale western cutworm. Hence, when this cutworm is abundant in a field nothing can be done to save the crop, and the field should never be re-sown until the cutworms have ceased feeding. Fortunately, methods of summer-fallowing are known by which re-infestation of the field for the succeeding year can be prevented. For these reasons it is especially necessary to recognize the pale western cutworm.

THE EARLY CUTWORM (*Euxoa tristicula* Morr.), was reported for the first time in 1925, when it was rather abundant in many parts of Saskatchewan and caused noteworthy injury. It was the early cutworm, followed later by the red-backed cutworm, which together caused such severe injury to early crops that season in parts of Saskatchewan. It is readily distinguished from the others by the fact that it winters as a partly grown cutworm and is ready to begin feeding in the spring as soon as growth starts. In colour this cutworm is rather variable although usually of lighter shades. The plants attacked are, as a rule, cut off fairly deeply in the soil, and seldom recover, especially when the latter is dry. The presence of this cutworm may always be detected in the soil by close observation during fall or spring cultivation, or when beginning to seed, especially if its abundance attracts birds in unusual numbers behind the cultivator. Where the early cutworm is observed to be abundant in a field seeding should invariably be delayed until about the last week in May, when this cutworm has ceased feeding; this general date may be readily determined by observing the disappearance of most of the large, conspicuous cutworms. If damage by the red-backed cutworm then develops, poisoned bait must be used as described below.

FORWARDING SPECIMENS

The characters given will usually serve to show which species of cutworm is at work in a field, so that control measures can be adopted without delay. However, until thoroughly familiar with the important kinds of cutworms occurring in a district, it is much better to send specimens to an entomologist for confirmation. This should invariably be done in Alberta or wherever the pale western cutworm is likely to occur. Send forward several living cutworms of all the kinds found in the field. For mailing they should be placed in a tin or wooden box nearly filled with soil and should be provided with some green plants for food. Such specimens should always be accompanied by a separate letter of explanation and sent to the Dominion Entomological Laboratory either at Treesbank, Manitoba; Saskatoon, Saskatchewan; or Lethbridge, Alberta.

²Entomological Branch circulars dealing with the pale western cutworm and its control may be had on request.

THE RED-BACKED CUTWORM

LIFE-HISTORY. Four stages occur in the development of the cutworm; the egg, the "worm" or caterpillar, the pupa or resting stage, and the moth, the fully developed insect which lays the eggs for the new generation.

In this species the winter is passed in the egg stage in the soil. These eggs, each smaller than the head of a common pin, hatch during the first extended warm spell of spring, producing the caterpillars or cutworms proper. These are tiny at first, but grow rapidly as the soil becomes warmer. About the middle of May, in normal years, they have become large enough to injure seriously the young plants and thus make their presence known. Even then, however, many at first fail to recognize these small caterpillars as cutworms. As they continue to grow, their appearance becomes more like that already described, and when full grown are nearly as thick as an ordinary pencil and average one and three-eighth inches in length.

Red-backed cutworms become mature and cease feeding during the latter part of June. Each then forms a firmly cemented cell at a depth of from one to two inches in the soil, and in it transforms to the inactive, dark reddish-brown pupa. It is from these pupae that the "millers" or moths (Fig. 2.) emerge in from three to four weeks.



FIG. 2. Moths of the red-backed cutworm; *a*, at rest; *b*, with wings spread; natural size. (After Gibson).

Moths are present in important numbers for about seven weeks, beginning late in July, during which period the eggs are laid. Each normal female is capable of laying more than one thousand eggs, a fact which accounts for the rapid increase of this species under favourable conditions.

HABITS OF THE MOTHS. Cutworm damage in the spring occurs only in those fields or portions of fields in which the parent moths laid eggs in abundance during the preceding summer. These moths hide by day among grass, weeds, shrubs or under clods, and come out after dark to feed on the nectar of the flowers, mate, and lay their eggs. For egg-laying, the moths seem almost invariably to select light or medium land, and to avoid wet, crusted earth or heavy land except when the surface layer is fine, loose and dry. The presence of thick vegetation, forming hiding places, and an abundance of flowers to serve as food near well cultivated fields, seems to favour a cutworm infestation therein the following spring.

Although closely related moths are often abundant around lights, those of the red-backed cutworm do not often come to light, and for this reason light traps are of no practical value in the control of this species.

HABITS OF THE CUTWORM. The cutworms come above the surface of the soil at night in search of food, and usually feed above the surface at that time. Sometimes when a plant is found the cutworm burrows beside it and cuts it off just below the surface, often dragging the leaves into the soil to feed on them. In dry, warm soil the cutting sometimes occurs deeper and just above the seed. Occasionally, with plants which do not wilt rapidly, a cutworm may thus feed

on a single plant for several days. In other cases it may move beneath the surface from plant to plant of a close-set row. Usually, however, *nearly all the cutworms come to the surface each warm night*, especially when the soil is not too dry. *It is this habit which makes possible the use of poisoned bait in controlling the red-backed cutworm.*

These cutworms are not "armyworms", for when on the surface at night they move about aimlessly, and any migration is slow and haphazard. They have been observed to remain for some weeks in an area which had been eaten so bare that they gnawed bits of stubble and hard, dried leaves. Under such circumstances, the development of the cutworms may be delayed a week or more. This is of great importance in connection with the re-seeding of fields or areas where the first seeding has been destroyed.

Under usual circumstances these cutworms are seldom seen above the surface until night has fallen. Under some conditions, however, they lose these nocturnal habits and are seen almost in armies, moving on the soil surface at midday even in hot sunlight. Indeed, the use of a plough furrow to restrict such movement has been reported to have been of value on rare occasions. This change in habit seems to be associated with fairly high temperatures, very moist air, and considerable moisture in the soil. It must be considered decidedly abnormal, although occurring widely in such a season as 1925.

NATURAL CONTROL FACTORS

Normally, the red-backed cutworm is kept fairly well in check by diseases, insect enemies, birds, and unfavourable weather conditions. When one or more of these fail over a small or large area, there is a local or general outbreak. Under such circumstances the farmer must institute control measures in order to protect the crops during the period of from the one to several years required for the natural agencies again to bring the insect under control.

One of the reasons that outbreaks of this cutworm cannot be predicted more accurately from year to year is that weather conditions of the current spring and early summer greatly affect the amount of damage caused by each cutworm. A warm period early in April, followed by a cool, dry spring, almost invariably results in increased damage, if the insect is present.

When heavy rains occur in May or June during a cutworm outbreak, many farmers assume that the necessity for using control measures is past, because it is felt that the rain will kill the cutworms. This is a mistake. The cutworms are not killed by heavy rains, although they are much more difficult to find when the soil is wet. It is true that the indirect effects of a *long period* of rain are very beneficial in the prairies; (1) because, in the case of cereals which can stool out, rapid growth of plants and recovery of partly damaged plants is encouraged, (2) the cutworms injure the plants less seriously, as they are forced to feed to a greater extent above ground and (3) because diseases among cutworms usually develop very rapidly under such conditions. It is probable that, with the very large number of cutworms present in 1925, the damage to cereal crops in that year, large as it was, would have been doubled or even trebled had the season been as dry as the summer of 1924. It is impossible, however, to depend on the weather to control the cutworms and under all conditions, with cutworms present in injurious numbers, control measures should be undertaken.

CONTROL

It is possible and practicable, with the following control measures, to reduce by fully one-half, the damage to field crops by the red-backed cutworm. The success of these measures depends largely upon an acquaintance with the habits of the cutworm, a knowledge of the control practices and upon the care taken to watch the fields for early signs of the presence of the insect.

FARM PRACTICES TO REDUCE DAMAGE. *Any cultural measures which result in an earlier, sturdier crop will reduce the damage to the small grains.* This is due to the fact that these crops are most susceptible to injury during the seedling stage, and the smaller the cutworms are at that time, the less the damage caused by each cutworm. Therefore, it is advisable to seed as soon as a moist seed-bed can be obtained warm enough to produce rapid growth. It is helpful to use a little extra seed, but not more than a peck per acre in addition to the usual amount. Packing after seeding is of considerable value in reducing damage and is also recommended by field husbandry authorities for almost all conditions on the prairies. There is no evidence that either packing or discing actually kills the cutworms. The packing is beneficial in that it tends to force the cutworms to feed above the surface, and by raising the moisture level aids germination and the growth of the plants.

The practices mentioned can be generally recommended for use in districts where loss by the red-backed cutworm is expected, even though many fields may not be infested.

There are no spring-sown crops free from cutworm attack. Little injury, however, has been observed in the case of fall rye or potatoes. Fall rye is strongly recommended for districts with lighter and poorer land where cutworm damage is likely to occur and for fall seeding in a field which has been in fallow, following the loss of the spring crop.

POISONED BAIT

For cutworms such as the red-backed cutworm, which come above the surface to feed, the use of poisoned baits has long been known to be the most efficient and practical remedy. This bait consists of bran, a poison, molasses and water, mixed together in suitable proportions. The best formula for prairie use is as follows:—

	Field quantities	Garden quantities
Bran.....	100 pounds	1 quart
White Arsenic, finely ground (or Paris Green—2 lbs.)....	4 pounds	1 teaspoonful
Cheap cane molasses (Blackstrap).....	1 gallon	1 tablespoonful
Water.....	7 to 8 gallons	To moisten.

The dry bran and arsenic should first be thoroughly mixed together, (during this process keep the nose and mouth covered with a damp cloth). The molasses should then be dissolved in the water and this mixture stirred slowly into the poisoned bran until it is thoroughly moistened and free from lumps. CAUTION: *Bags of poisoned bait, should be kept out of reach of stock and children, and empty bags used for the bait should be burned when no longer used for this purpose.*

Under some conditions it is possible to use fine sawdust or fine oat chop instead of part of the bran or to reduce the amount of molasses. These changes have not yet been thoroughly tested, so that at present we recommend only the mixture given above.

For community use, mixing machines, such as were used during the grasshopper campaigns, will greatly reduce the cost and trouble of mixing. Where machines are not available, large tubs or a concrete floor will serve for mixing the bait.

METHOD AND CONDITIONS OF APPLICATION. For success in the use of this bait, *three conditions are essential; uniform spreading over the surface, application during the evening, and favourable temperature conditions.*

The poisoned bait should be broadcasted thinly and evenly wherever it is desired to kill the cutworms. The general tendency is to spread the bait more thickly than is necessary, but when correctly used it is so thinly spread

out that it can be seen only on close examination of the ground, and when spread in this way no injury to birds, chickens, or stock has been observed. To secure an even but thin and rapid distribution on a large scale, machines of the type of the end-gate seeder, but with heavier fan blades, such as were used during the grasshopper campaigns, should be useful. In the absence of these machines broadcasting by hand from the back of a wagon is convenient.

Since these cutworms usually do not feed above the surface until after dark, it is important that the bait be put out in the evening and that it be as fresh as possible at the time the cutworms are likely to feed upon it. It is essential also that a warm, but not hot, evening be chosen for its application. On the other hand, if a thermometer in the shade registers less than fifty degrees Fahrenheit, at sundown, it will be too cold for good results, and the bait should not be put out. Many reported failures in the use of the control have been traced to unfavourable temperatures. Particularly good results can be obtained when the soil is moist; hence, whenever it is possible, spread the bait soon after rain if the temperature is suitable. This treatment is most effective when there is little other food available, hence the importance of spreading bait as soon as the first damage is noticed, and before much of the crop is up. However the cutworms have been repeatedly observed to feed on the bait apparently in preference to tender seedlings of all kinds.

The red-backed cutworm feeds quite readily on virtually every kind of plant found in cultivated fields, yet there are important differences in the attractiveness of different plants, as well as in their susceptibility to injury.

SWEET CLOVER, FLAX, SUNFLOWERS AND CORN. It is essential to use poisoned bait in fields of sweet clover, flax, sunflowers and corn, wherever and as soon as the first evidences of cutworm injury are noticed in them. These plants are very susceptible to cutworm attack because none of them have any power of recovery when once cut. In the case of sunflowers and corn there are relatively few plants for the cutworm to attack and damage from a few cutworms is proportionately high. The seedlings of sweet clover and flax are more numerous, but are so small that several can be destroyed each night by a single cutworm, and an infestation, even at the low rate of two or three cutworms per square foot, can completely ruin a promising stand. One of the occurrences in 1925 which puzzled farmers most, was the disappearance of most of the young sweet clover in a field without apparent injury to the nurse crop. Similar selective feeding also occurred when flax and wheat were seeded together. Virtually all of this type of loss was due to cutworms. Second year sweet clover also sustained marked injury and in 1925 much of the supposed "winter killing" was actually due to the red-backed cutworm.

The great importance of these crops in the rotation, to add nitrogen to the soil, for hay, pasture or ensilage, as intertilled crops in summer-fallow substitute and as cash crops, makes it doubly important to protect them. The essentials of success are: a close watch during cutworm seasons to detect the first evidences of injury, and an immediate and general application of the bait preferably before much of the crop is up.

SMALL GRAINS. The damage caused to wheat, oats, barley, rye and seedling grasses, is often very severe, particularly during dry weather, but, with an equal number of cutworms, not as serious as in the case of the other crops just discussed. There are two main reasons for this: first, when any other plants, such as weed seedlings, are available, cutworms will seldom feed on the cereals, once they have passed the tender seedling stage; and, second, the small grains have great powers of recovering from moderate injury by stooling out

especially when weather conditions are favourable for their rapid growth. For these reasons the recommendations as to the use of poisoned bait with small grains are different.

It is not advisable to use bait where the cutworms are merely slightly thinning one of these crops, especially under promising crop conditions. On the other hand, cutworms are frequently so numerous that, unless they are controlled, large patches or whole fields of grain will be eaten bare. Where severe infestation is indicated, spread the bait at once on the attacked areas, to save the crop and to prevent the spread of infestation. Such areas will frequently be at the edges of the fields, or on knolls or other patches of lighter, drier soil.

It is always better and less costly to save the first seeding than to re-seed, as in dry years a late crop usually yields much less than an early one, and in wet years any delay in the maturity of wheat usually means much heavier rust injury.

IS IT PRACTICAL TO USE BAIT IN FIELDS? In fields, because of the area to be covered and the low unit value of the crops, hesitation has been shown in trying the poisoned bait control. One reason for this lies in the fact that cutworm feeding occurs at night, and hence, unlike the conspicuous grasshoppers, cutworms are seldom seen. The bait is undoubtedly effective against the red-backed cutworm. Its effect can be observed directly by spreading fresh bait in part of an infested field on a warm evening, and later, about ten o'clock, by the light of a lantern or flashlight watching the cutworms feed upon it. Two days later a search of part of the poisoned area will show the effect of the treatment, in that few living cutworms will be found.

The cost of the bait treatment is very much less than is commonly realized, and the outlay required is so small in proportion to the savings in crop that there should be no objection to its use. With a little practice the amount of bait in the field-quantity formula can be made to spread completely over at least five acres, and at 1925 prices the cost for material at this rate was only \$0.75 per acre. Where treatment is required upon a number of neighbouring farms, co-operation in mixing and spreading the bait will make it inexpensive and comparatively simple, as soon as a little experience is gained.

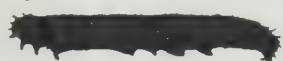
In many instances, in 1925, farmers lost two, three or even four seedings in the same field; a loss which would have been avoided by the use of poisoned bait early in the season. The cost of a single seeding is at least \$1.25 per acre, and the labour involved is much greater than that required for spreading bait. In addition, this second seeding must also be protected by the use of bait, or re-seeding delayed until the cutworm feeding has ended. The late crop will not mature, or the yield from it will seldom be more than one-half that of the earlier crop. Therefore, do not hesitate to give this method a thorough trial.

RE-SEEDING FIELDS DAMAGED BY THE RED-BACKED CUTWORM

It is never safe to re-seed a field, in which the first crop has been destroyed by cutworms, until these have been killed or until they are full grown and have ceased feeding. If the cutworms are able to destroy a first seeding while they are only half-grown, they will certainly attack a second crop, which is just appearing above the ground, when they are nearly full grown. Where cutworms have destroyed the first seeding, two alternatives are possible, (1) to re-seed at once, and protect the crop with bait, or, (2) to wait until the cutworms are mature before re-seeding.

RE-SEEDING WHEN POISONED BAIT IS USED. Patches or fields of crop destroyed by the red-backed cutworm should be re-sown at once, provided the poisoned bait is spread during the first suitable evening which follows the seeding. This practice is strongly recommended, since it permits the use of the same crop as in the remainder of the field, with very little delay in time of maturity. In replanting, any suitable crop may be used as the danger of cutworm attack has been removed.

RE-SEEDING AFTER THE CUTWORMS ARE FULL-GROWN. Many farmers hesitate to use poisoned bait even where the first seeding has been destroyed. Under such circumstances re-seeding should not be undertaken until the cutworms are full grown and have ceased feeding. In the case of the red-backed cutworm this is usually about June 20, but may be as much as ten days earlier or later depending on the season and the conditions in the infested field. A chart is given below to enable the farmer to decide when it is safe to re-seed. The chart indicates, approximately, how long it will take red-backed cutworms of various sizes to become full grown, and when the infested field can be re-sown with assurance that the second seeding will be free from their attack.



(1-inch)—Do not re-seed in less than 2 weeks.



(1½-inch)—Full grown. Re-seed in about 1 week's time.

To use the chart collect a number of cutworms from several parts of the damaged field and pick out some of *average* size. Submerge them in water for ten minutes to quiet them, dry them on blotting paper, straighten them out, and compare them with the chart. If the *average* cutworms are one inch in length it is not safe to reseed in less than two weeks. Where the cutworms are less than one inch when measured, wait until they have grown somewhat, when they should be measured again and the instruction of the chart followed.

Only a few crops are of value for late re-seeding. Oats are probably the best because they can be used for green feed, hay, or sheaf feed if they do not have time to mature. An early variety of barley is useful, but flax should not be used.

When there is a long period of warm, wet weather in June, as in 1925, many or most of the cutworms are usually destroyed by disease. The presence of disease is indicated, when numerous red-backed cutworms are found crawling over the surface of the ground or climbing plants in the bright sunshine. Numbers of dark-coloured, distorted, dead cutworms found attached to plants, fence posts, or seen on the surface of the soil, indicate with certainty the presence of disease and, under such circumstances, it is often safe to re-seed a week or more earlier than otherwise would be the case.

PREVENTIVE MEASURES IN FIELDS

It would be very desirable if the moths could be prevented from laying eggs in fields, or the eggs or young cutworms destroyed by methods of cultivation. No absolute relation between culture and infestation is yet clear. In 1925, crops following cereals, sunflowers or corn, were severely injured after summer-fallow or stubble, either clean or weedy, and after fall ploughing, spring plough-

ing or discing; though on the whole, crops following fallow have been most affected. As a result of observations on the egg-laying habits, and by other studies in the fields, certain methods of summer-fallowing can be recommended tentatively:—

Cultivate frequently during the spring and early summer to bring the weeds under control and conserve moisture. Plough deeply in mid-July, finishing if possible by July 20, using a section of harrow behind the plough, but otherwise leave the surface as rough as is permissible, with due regard to moisture conservation. Allow the land to crust and remain unworked until after the first week in September; then cultivate to destroy the weeds. The essential point is to have the fallow crusted over, during the period of flight, roughly from July 20 to Sept. 5, in order to make the lands unsuitable for egg-laying by the moths.

A summer-fallowing method, of very much the same type, is being widely recommended in some districts for the control of weeds, and it is believed to be of general value. In the greater part of the area where the red-backed cutworm may be important, weeds are also very important, and their control should be considered first in cultivation. Cultural modifications, for the purpose of reducing infestation by the cutworm the following spring, should only be used in districts where the cutworm is abundant, and where an outbreak may reasonably be expected again the next year. In other years or in other districts, it is advised that the usual cultural methods be continued.

The absence, as yet, of cultural methods fully efficient in preventing infestation by the red-backed cutworm, serves to emphasize the value of poisoned bait for this species. It should again be stated that, in the case of the pale western cutworm, cultural methods afford the only practical control.

CONTROL IN GARDENS

The red-backed cutworm attacks such diverse plants as radishes, tomatoes, onions, and large plants of rhubarb, flowers of all kinds, and seedlings of such shrubs as caragana. A full list of the plants attacked would include nearly every kind grown in the garden.

Of this loss caused by the cutworms in gardens, fully 90 per cent can be prevented at a small cost by the use of the poisoned bait. As soon as there is any evidence of severe cutworm infestation, broadcast the bait generally throughout the garden at the rate of forty pounds of bait per acre, or use it along the rows or around individual plants of special value. When applied according to the directions given, there is no need to lose more than a few plants, as market gardeners who have used the bait have proven. The amount of bait in the smaller formula is sufficient for a plot twenty feet by forty feet, and the cost is negligible in comparison with the high degree of protection which results.

In small gardens, it is often possible to control cutworms by locating them in the soil near plants they have cut, and destroying them. The more valuable plants, such as cabbages and tomatoes, may be protected by placing a band of tin or wrapping paper around the stem of each plant when it is set out. This band should extend about three inches into the soil and as much above the surface.

No seed treatments are at present known which will prevent injury by this insect; although it is sometimes advocated that lime, salt, or one of several commercial preparations be used in the soil to destroy the cutworms. No substance is known at the present time that could be used in effective quantity without being detrimental to the plants.

SOURCES OF INFORMATION

Specimens of cutworms or other insects submitted for determination should be sent to the local Dominion Entomological Laboratory. Information relating to insects may be obtained from any of the following:—

The Dominion Entomologist, Entomological Branch, Ottawa.

The Dominion Entomological Laboratories at Treesbank, Man., Saskatoon, Sask., and Lethridge, Alta.

The Provincial Departments of Agriculture at Winnipeg, Man., Regina, Sask., and Edmonton, Alta.

The Provincial Colleges of Agriculture at Winnipeg, Man., Saskatoon, Sask., and Edmonton, Alta.

